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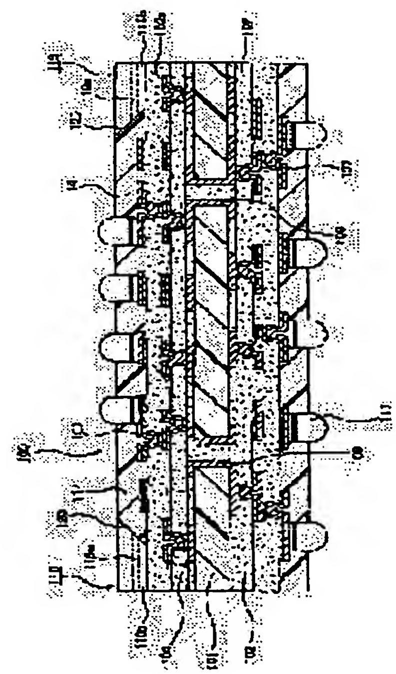
(54) MULTILAYER PRINTED CIRCUIT BOARD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a multilayer printed circuit board which can transmit both an optical signal and an electric signal, and contribute to the miniaturization of terminal equipment for an optical communication.
SOLUTION: In the multilayer printed circuit board in which a conductor circuit and an inter-layer a resin insulation layer are laminated on both sides of a substrate and a solder resist layer is formed in the outermost layer, an organic optical waveguide is formed in part of the solder resist layer.



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CLAIMS

[Claim(s)]

[Claim 1] both sides of a substrate — a conductor — the multilayer printed wiring board which laminating formation of a circuit and the resin insulating layer between layers is carried out, and is a multilayer printed wiring board with which the solder resist layer was formed in the outermost layer, and is characterized by forming organic system optical waveguide in said a part of solder resist layer.

[Claim 2] The multilayer printed wiring board according to claim 1 with which opening for mounting the substrate for IC chip mounting in said solder resist layer is formed.

[Claim 3] both sides of a substrate — a conductor — the multilayer printed wiring board which a circuit and the resin insulating layer between layers are the multilayer printed wiring boards by which laminating formation was carried out, and is characterized by boiling all on the resin insulating layer between layers of the outermost layer of one side, and forming organic system optical waveguide.

[Claim 4] Said organic system optical waveguide is a multilayer printed wiring board according to claim 3 which consists of the core section and the clad section.

[Claim 5] A multilayer printed wiring board given in any 1 of claims 1-4 in which the optical waveguide for light-receiving and the optical waveguide for luminescence are formed as said organic system optical waveguide.

[Claim 6] the conductor which sandwiched said resin insulating layer between layers — a multilayer printed wiring board given in any 1 of claims 1-5 to which circuits are connected by the Bahia hall.

[Claim 7] said conductor — a multilayer printed wiring board given in any 1 of claims 1-6 in which the circuit is formed by the additive process.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a multilayer printed wiring board.
[0002]
[Description of the Prior Art] In recent years, attentions have gathered for the optical fiber focusing on the communication link field. In especially IT (information technology) field, the communication technology which used the optical fiber for maintenance of the high-speed Internet network is needed. In the communication system using the optical fiber which has the descriptions, such as 1 low loss, 2 high bandwidth, 3 narrow diameters and a light weight, no 4 guiding, and 5 saving resources, and has this description, compared with the communication system using the conventional metallic cable, the number of repeaters can be reduced substantially, construction and maintenance become easy, and an optical fiber can attain economization of communication system, and high-reliability-ization.
[0003] Moreover, since an optical fiber can multiplex simultaneously the light of the wavelength from which not only the light of one wavelength but many differ with one optical fiber, it can realize the transmission line of the large capacity which can respond to various applications, and can respond to image service etc.
[0004] Then, in network communication, such as such the Internet, using the optical communication using an optical fiber not only for the communication link of a backbone but for the communication link with a backbone and terminal equipments (a personal computer, mobile one, game, etc.) and the communication link of terminal equipments is proposed. Thus, when using optical communication for the communication link with a backbone and a terminal equipment etc., in order for IC which performs information (signal) processing in a terminal equipment to operate with an electrical signal, it is necessary to attach the equipment (henceforth light/electric transducer) which changes the lightwave signal and electrical signal of optical -> electric transducer, electric -> phototransducer, etc. into a terminal equipment. So, in the conventional terminal equipment, the optical waveguide which transmits the lightwave signal sent from the outside through an optical fiber etc. to light/electric transducer, for example, or transmits the lightwave signal sent from light/electric transducer to an optical fiber etc., and the multilayer printed wiring board which transmits an electrical signal through a solder bump were mounted independently, and a signal transmission and signal processing were performed.
[0005]
[Problem(s) to be Solved by the Invention] In such a conventional terminal equipment, since optical waveguide and a multilayer printed wiring board were mounted independently, the whole equipment became large and had become the factor which bars the miniaturization of a terminal equipment.
[0006]
[Means for Solving the Problem] Then, as a result of examining wholeheartedly the multilayer printed wiring board which can be contributed to the miniaturization of a terminal equipment, by forming optical waveguide in a multilayer printed wiring board, this invention persons hit on an idea for the technical problem mentioned above to be solvable, and completed the multilayer printed wiring board of this invention which consists of the following configuration.
[0007] namely, the multilayer printed wiring board of the first this invention — both sides of a substrate — a conductor — laminating formation of a circuit and the resin insulating layer between layers is carried out, and it is the multilayer printed wiring board with which the solder resist layer was formed in the outermost layer of drum, and is characterized by forming organic system optical waveguide in said a part of solder resist layer.
[0008] In the multilayer printed wiring board of the first this invention, it is desirable to form opening for mounting the substrate for IC chip mounting in the above-mentioned solder resist layer.
[0009] the multilayer printed wiring board of the second this invention — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the multilayer printed wiring boards by

which laminating formation was carried out, and it is characterized by boiling all on the resin insulating layer between layers of the outermost layer of drum of one side, and forming organic system optical waveguide.

[0010] As for the above-mentioned organic system optical waveguide, in the multilayer printed wiring board of the second this invention, it is desirable to consist of the core section and the clad section.

[0011] Moreover, in the first or the second multilayer printed wiring board, it is desirable as the above-mentioned organic system optical waveguide to form the optical waveguide for light-receiving and the optical waveguide for luminescence.

[0012] moreover, the conductor which sandwiched the above-mentioned resin insulating layer between layers in the first or the second multilayer printed wiring board — circuits are connected by the Bahia hall — desirable — the above — a conductor — as for a circuit, being formed by the additive process is desirable.

[0013]

[Embodiment of the Invention] Hereafter, the multilayer printed wiring board of the first this invention is explained first. the multilayer printed wiring board of the first this invention — both sides of a substrate — a conductor — laminating formation of a circuit and the resin insulating layer between layers is carried out, and it is the multilayer printed wiring board with which the solder resist layer was formed in the outermost layer of drum, and is characterized by forming organic system optical waveguide in a part of above-mentioned solder resist layer.

[0014] the multilayer printed wiring board of the first this invention — a conductor — since both a lightwave signal and an electrical signal can be transmitted since a circuit and organic system optical waveguide are formed, and organic system optical waveguide is formed in the multilayer printed wiring board, it can contribute to the miniaturization of the terminal equipment for optical communication.

[0015] Organic system optical waveguide is formed in a part of solder resist layer in the above-mentioned multilayer printed wiring board. Therefore, a lightwave signal can be transmitted through the above-mentioned organic system optical waveguide. Moreover, organic system optical waveguide is easily processible while excelling in adhesion with the resin insulating layer between layers.

[0016] The resin complex of the resin and thermosetting resin with which it was not limited as an ingredient of the above-mentioned organic system optical waveguide especially when there was little absorption by the communication link wavelength range, for example, some of thermosetting resin, thermoplastics, photopolymers, and thermosetting resin were photosensitivity-ized, and thermoplastics, the complex of a photopolymer and thermoplastics, etc. are mentioned. Specifically, silicone resin, such as polyimide resin, such as acrylic resin, such as PMMA (polymethylmethacrylate), Deuteration PMMA, and heavy hydrogen fluorination PMMA, and fluorination polyimide, an epoxy resin, UV hardenability epoxy resin, polyolefine system resin, and deuteration silicone resin, the polymer manufactured from benz-cyclo-butene are mentioned.

[0017] Moreover, particles, such as for example, a resin particle, an inorganic particle, and metal particles, may be contained in the above-mentioned organic system optical waveguide in addition to the above-mentioned resinous principle. It is because adjustment of a coefficient of thermal expansion can be aimed at by including these particles between the above-mentioned organic system optical waveguide, the resin insulating layer between layers, a solder resist layer, etc. What consists of resin complex of thermosetting resin, thermoplastics, a photopolymer, the resin with which some thermosetting resin was photosensitivity-ized, thermosetting resin, and thermoplastics, complex of a photopolymer and thermoplastics, etc. as the above-mentioned resin particle, for example is mentioned.

[0018] Specifically For example, an epoxy resin, phenol resin, polyimide resin, Thermosetting resin, such as a bismaleimide resin, polyphenylene resin, polyolefin resin, and a fluororesin; The heat-curing radical of these thermosetting resin A methacrylic acid, an acrylic acid, etc. are made to react to (for example, the epoxy group in an epoxy resin). Resin which gave the acrylic radical; Phenoxy resin, polyether sulfone (PES), Thermoplastics, such as polysulfone (PSF), a polyphenylene sulfone (PPS), polyphenylene sulfide (PPES), a polyphenyl ether (PPE), and polyether imide (PI); what consists of photopolymers, such as acrylic resin, etc. is mentioned. Moreover, what consists of resin complex of the resin complex of the above-mentioned thermosetting resin and the above-mentioned thermoplastics, the resin which gave the above-mentioned acrylic radical, the above-mentioned photopolymer, and the above-mentioned thermoplastics can also be used. Moreover, the resin particle which consists of rubber can also be used as the above-mentioned resin particle.

[0019] Moreover, as the above-mentioned inorganic particle, what consists of titanium compounds, such as silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, and basic magnesium carbonate, a silica, and a zeolite, and a titania, etc. is mentioned, for example. Moreover, what was made to mix and carry out melting of a silica and the titania at a fixed rate, and was equalized may be used. Moreover, what consists of

Lynn or phosphorus compounds can also be used as the above-mentioned inorganic particle.
[0020] As the above-mentioned metal particles, what consists of gold, silver, copper, palladium, nickel, platinum, iron, zinc, lead, aluminum, magnesium, calcium, etc. is mentioned, for example. These resin particles, an inorganic particle, and the particle of metal particles may be used independently, respectively, and may be used together two or more sorts.
[0021] Moreover, especially the configuration of particles, such as the above-mentioned resin particle, is not limited, for example, the shape of a globular shape, an ellipse globular shape, the letter of crushing, and a polyhedron etc. is mentioned. Moreover, as for the particle size (the die length of the longest part of a particle) of the above-mentioned particle, it is desirable that it is shorter than communication link wavelength. It is because transmission of a lightwave signal may be checked when particle size is longer than communication link wavelength. Moreover, as long as it is the particle which has the particle size of above-mentioned within the limits, the particle of two or more kinds of different particle size may be contained.
[0022] As for the loadings of the particle which the above-mentioned organic system optical waveguide contains, it is desirable that it is 10 - 80 % of the weight, and it is more desirable that it is 20 - 70 % of the weight. It is because transmission of a lightwave signal may be checked when the effectiveness with which a particle will be combined if the loadings of a particle are less than 10 % of the weight may not be acquired and the loadings of a particle exceed 80 % of the weight.
[0023] Moreover, although especially the configuration of the above-mentioned organic system optical waveguide is not limited, since the formation is easy, the shape of a sheet is desirable. Moreover, the thickness of the above-mentioned organic system optical waveguide has desirable 5-100 micrometers, and the width of face has desirable 5-100 micrometers. the conductor which constitutes a multilayer printed wiring board if the above-mentioned width of face is not sometimes easy for the formation in less than 5 micrometers and the above-mentioned width of face exceeds 100 micrometers on the other hand — it is because it may become the cause which checks the degree of freedom of designs, such as a circuit.
[0024] Moreover, the ratio of the thickness of the above-mentioned optical waveguide and width of face has a desirable way near 1:1. It is because the loss at the time of transmitting a lightwave signal becomes larger as the ratio of the above-mentioned thickness and width of face shifts from 1:1. Furthermore, when the above-mentioned optical waveguide is the optical waveguide of a single mode on the communication link wavelength of 1.55 micrometers, as for the thickness and width of face, it is more desirable that it is 5-15 micrometers, and when the above-mentioned optical waveguide is the optical waveguide of a multimode on the communication link wavelength of 0.85 micrometers, it is more desirable [the thickness and width of face] that it is 20-80 micrometers.
[0025] In the above-mentioned multilayer printed wiring board, it is desirable as organic system optical waveguide to form the optical waveguide for light-receiving and the optical waveguide for luminescence. The above-mentioned optical waveguide for light-receiving means the organic system optical waveguide for transmitting the lightwave signal sent from the outside through an optical fiber etc. to a photo detector, and the above-mentioned optical waveguide for luminescence means the organic system optical waveguide for transmitting the lightwave signal sent from the light emitting device to an optical fiber etc. Moreover, it is desirable for the above-mentioned optical waveguide for light-receiving and the above-mentioned optical waveguide for luminescence to be what consists of the same ingredient. It is because adjustment of a coefficient of thermal expansion etc. is easy for a scale or the formation to like.
[0026] Moreover, it is desirable to form the optical-path conversion mirror in the above-mentioned organic system optical waveguide. By forming an optical-path conversion mirror, it is because it is possible to change an optical path into a desired include angle. Formation of the above-mentioned optical-path conversion mirror can be performed by cutting the end of organic system optical waveguide so that it may mention later.
[0027] Moreover, the above-mentioned organic system optical waveguide is formed in a part of solder resist layer as mentioned above. Therefore, the solder resist layer will be formed in the organic system optical waveguide agenesis section of the outermost layer of drum of the above-mentioned multilayer printed wiring board. since [thus,] the solder resist layer is formed — this solder resist layer — the resin insulating layer between layers, and a conductor — a circuit can be protected.
[0028] Moreover, it is desirable to form opening for mounting opening and surface mount mold electronic parts for mounting the substrate for IC chip mounting in the above-mentioned solder resist layer, and it is desirable to form opening of the BGA pad for mounting the substrate for IC chip mounting especially. When opening described above in the solder resist layer is formed, the substrate for IC chip mounting and surface mount mold electronic parts can be mounted on the surface of a multilayer printed wiring board, and, specifically, substrates for IC chip mounting, such as BGA in which the light emitting device and the photo detector are mounted with IC chip, can be mounted in the side in which the optical waveguide of a multilayer printed wiring board was formed.

[0029] Moreover, the solder resist layer may be formed also in the outermost layer of drum of a near substrate in which optical waveguide was not formed, and opening for mounting surface mount mold electronic parts etc. in this solder resist layer may be formed. When such opening is formed, after forming the pad for surface mounts in this opening if needed, surface mount mold electronic parts can be mounted. Moreover, PGA (Pin Grid Array) and BGA (Ball Grid Array) can also be arranged in this opening, and, thereby, a multilayer printed wiring board, an external substrate, etc. can also be electrically connected to it.

[0030] Moreover, in the multilayer printed wiring board of the first this invention, when the external substrates (substrate for IC chip mounting etc.) with which optical elements, such as a light emitting device and a photo detector, were mounted are connected to the side in which the above-mentioned organic system optical waveguide is formed through a solder bump, the above-mentioned multilayer printed wiring board and the above-mentioned external substrate can be certainly arranged to a position according to the self-alignment operation which solder has. Therefore, if the installation location of the organic system optical waveguide in the multilayer printed wiring board of this invention and the installation location of the optical element in the above-mentioned external substrate are exact, an exact lightwave signal can be transmitted among both.

[0031] In addition, it is thought that it happens in order that the surface tension which is going to become a globular form when solder is attached to a metal, while the operation which is going to exist in a stable configuration by near the center of opening with the fluidity to which self has [solder] a self-alignment operation at the time of reflow processing is said and, as for this operation, solder is crawled by the solder resist layer may work strongly. Though location gap has occurred to both in front of a reflow in case the above-mentioned external substrate is connected the above-mentioned multilayer printed wiring board top through the above-mentioned solder bump when this self-alignment operation is used, the above-mentioned external substrate can move at the time of a reflow, and this external substrate can be attached in the exact location on the above-mentioned multilayer printed wiring board.

[0032] moreover, the conductor which sandwiched the resin insulating layer between layers in the multilayer printed wiring board of the first this invention — it is desirable between circuits for the Bahia hall to connect. a conductor — connecting circuits in the Bahia hall — a conductor — while being able to wire a circuit by high density — a conductor — since the degree of freedom of a design of a circuit improves, the formation field of organic system optical waveguide is easily securable. moreover, the above — a conductor — as it is in explanation of the manufacture approach of the multilayer printed wiring board mentioned later, as for a circuit, being formed by the additive process is desirable. an additive process — the spacing — the conductor of detailed wiring of 50 micrometers or less — it is because it is suitable for forming a circuit. In addition, the above-mentioned additive process may be a fully-additive process, and may be a semiadditive process. moreover, the above — a conductor — the circuit may be formed by the build up method.

[0033] An example of the operation gestalt of the multilayer printed wiring board which consists of the above-mentioned configuration hereafter is explained referring to a drawing. Drawing 1 is the sectional view showing typically 1 operation gestalt of the multilayer printed wiring board of the first this invention.

[0034] it is shown in drawing 1 — as — a multilayer printed wiring board 100 — both sides of a substrate 101 — a conductor — the conductor with which laminating formation was carried out and the substrate 101 of the resin insulating layer [a circuit 104 and] 102 between layers was pinched — the conductor which sandwiched circuits and the resin insulating layer 102 between layers — circuits are electrically connected by the through hole 109 and the Bahia hall 107, respectively. Moreover, the solder resist layer 114 equipped with the solder bump 117 is formed in an outermost layer of drum, and the organic system optical waveguides 118 and 119 equipped with the optical-path conversion mirror 120 are formed in a part of solder resist layer 114. In addition, it consists of the core sections 118a and 119a and the clad sections 118b and 119b, and as for these organic system optical waveguides 118 and 119, one side is the optical waveguide for light-receiving, and another side of the organic system optical waveguides 118 and 119 is the optical waveguide for luminescence, respectively.

[0035] In the multilayer printed wiring board 100 which consists of such a configuration, the lightwave signal sent from the outside through an optical fiber (not shown) etc. will be introduced into the organic system optical waveguide 118 (core section 118a), and will be sent to a photo detector (not shown) etc. through the optical-path conversion mirror 120. moreover, the lightwave signal sent out from the light emitting device (not shown) etc. is introduced into the organic system optical waveguide 119 (core section 119a) through the optical-path conversion mirror 120, and is delivery outside as a lightwave signal through an optical fiber (not shown) etc. further — it will be carried out.

[0036] Moreover, when it connects with the substrate for IC chip mounting, other external substrates (not shown), etc. through the solder bump 117, a multilayer printed wiring board 100, the substrate for IC chip mounting, etc. can be connected electrically, and further, when the optical element is mounted in this substrate for IC chip mounting etc., a lightwave signal and an electrical signal can be transmitted between a multilayer

printed wiring board 100 and an external substrate. In addition, the multilayer printed wiring board of the first this invention which consists of such a configuration can be used as a package substrate, a mother board, a daughter board, etc. by forming opening for mounting the substrate for IC chip mounting, and surface mount mold electronic parts in a solder resist layer, or choosing no, whether BGA and PGA are arranged again, no, etc. suitably.

[0037] Next, how to manufacture the multilayer printed wiring board of the first this invention is explained.

(1) an insulating substrate — a start ingredient — carrying out — first — this insulating substrate top — a conductor — form a circuit. As the above-mentioned insulating substrate, a glass epoxy group plate, a polyester substrate, a polyimide substrate, a bismaleimide-triazine (BT) resin substrate, a thermosetting polyphenylene ether substrate, copper clad laminate, a RCC substrate, etc. are mentioned, for example. Moreover, ceramic substrates, such as an alumimium nitride substrate, and a silicon substrate may be used. the above — a conductor — a circuit can be formed by performing etching processing, after forming a solid conductor layer in the front face of for example, the above-mentioned insulating substrate by nonelectrolytic plating processing etc. Moreover, you may form by performing etching processing to copper clad laminate or a RCC substrate.

[0038] moreover, the conductor whose above-mentioned insulating substrate was pinched — in making connection between circuits by the through hole, after using a drill, laser, etc. for example, for the above-mentioned insulating substrate and forming a breakthrough, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned breakthrough is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.

[0039] (2) next, the need — responding — a conductor — perform roughening formation processing on the surface of a circuit. as the above-mentioned roughening formation processing — melanism (oxidization) — the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. can be mentioned. the case where a roughening side is formed here — the average relative roughness of this roughening side — usually — 0.1-5 micrometers — desirable — a conductor — the adhesion of a circuit and the resin insulating layer between layers, and a conductor — when the effect to the electrical signal transmission ability of a circuit etc. is taken into consideration, 2-4 micrometers is more desirable. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.

[0040] (3) next, a conductor — form the resin layer which forms the resin layer which is not hardened [which some of thermosetting resin photopolymers, and thermosetting resin become from the acrylic-ized resin, these and thermoplastics, and the included resin complex] on the substrate in which the circuit was formed, or consists of thermoplastics. The resin layer which is not hardened [above-mentioned] can be formed by applying non-hardened resin by the roll coater, a curtain coating machine, etc., or carrying out thermocompression bonding of the resin film non-hardened (semi-hardening). Moreover, the resin layer which consists of the above-mentioned thermoplastics can be formed by carrying out thermocompression bonding of the resin Plastic solid fabricated in the shape of a film.

[0041] In these, the approach of carrying out thermocompression bonding of the resin film non-hardened (semi-hardening) is desirable, and sticking by pressure of a resin film can be performed for example, using a vacuum laminator etc. Moreover, although what is necessary is not to limit especially sticking-by-pressure conditions, but just to choose suitably in consideration of the presentation of a resin film etc., it is usually desirable to carry out on a pressure 0.25 - 1.0MPa, the temperature of 40-70 degrees C, the degree of vacuum of 13-1300Pa, and about [time amount 10-120 second] conditions.

[0042] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyester resin, a bismaleimide resin, polyolefine system resin, polyphenylene ether resin, polyphenylene resin, a fluororesin, etc. are mentioned, for example. As an example of the above-mentioned epoxy resin, novolak mold epoxy resins, such as a phenol novolak mold and a cresol novolak mold, the cycloaliphatic epoxy resin which carried out dicyclopentadiene conversion are mentioned, for example.

[0043] As the above-mentioned photopolymer, acrylic resin etc. is mentioned, for example. Moreover, the thing to which the heat-curing radical, and the methacrylic acid and acrylic acid of the above-mentioned thermosetting resin were made to acrylic—ization-react as resin which acrylic-ized some above-mentioned thermosetting resin for example, is mentioned.

[0044] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone (PES), polysulfone (PSF), polyphenylene sulfone (PPS) polyphenylene sulfide (PPES), polyphenylene ether (PPE) polyether imide (PI), etc. are mentioned, for example.

[0045] Moreover, as the above-mentioned resin complex, especially if thermosetting resin, a photopolymer (the resin which acrylic-ized some thermosetting resin is also included), and thermoplastics are included, it will not be limited, but as a concrete combination of thermosetting resin and thermoplastics, phenol resin / polyether sulfone, polyimide resin/polysulfone, an epoxy resin / polyether sulfone, an epoxy resin/phenoxy resin, etc. are mentioned, for example. Moreover, as a concrete combination of a photopolymer and thermoplastics, acrylic resin/phenoxy resin, an epoxy resin / polyether sulfone etc. that acrylic-ized a part of epoxy group are mentioned, for example.

[0046] Moreover, as for the rate of a compounding ratio of thermosetting resin and the photopolymer in the above-mentioned resin complex, and thermoplastics, thermosetting resin or a photopolymer / thermoplastics =95 / 5 - 50/50 are desirable. It is because a high toughness value is securable, without spoiling thermal resistance.

[0047] Moreover, the above-mentioned resin layer may consist of resin layers from which it differs more than two-layer. It is that a lower layer is formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =50/50, and the upper layer is specifically formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =90/10 etc. While securing the adhesion which was excellent with the insulating substrate etc. by making it such a configuration, the formation ease at the time of forming opening for the Bahia halls etc. at an after process is securable.

[0048] Moreover, the above-mentioned resin layer may be formed using the resin constituent for roughening side formation. The matter of fusibility is distributed to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer into the heat-resistant-resin matrix which is not hardened [poorly soluble] to the roughening liquid which serves as the above-mentioned resin constituent for roughening side formation from at least one sort chosen from an acid, alkali, and an oxidizer. In addition, when the same time amount immersion is carried out, the word of the above "poor solubility" and "fusibility" says relatively what has an early dissolution rate as "fusibility" to the same roughening liquid for convenience, and calls "poor solubility" relatively what has a late dissolution rate to it for convenience.

[0049] In case the above-mentioned roughening liquid is used for the resin insulating layer between layers and a roughening side is formed as the above-mentioned heat-resistant-resin matrix, what can hold the configuration of a roughening side is desirable, for example, thermosetting resin, thermoplastics, these complex, etc. are mentioned. Moreover, by using a photopolymer, exposure and a development may be used for the resin insulating layer between layers, and opening for the Bahia halls may be formed.

[0050] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyolefin resin, a fluororesin, etc. are mentioned, for example. Moreover, when sensitization-izing the above-mentioned thermosetting resin, a heat-curing radical is made to acrylic(meta)—ization-react using a methacrylic acid, an acrylic acid, etc.

[0051] As the above-mentioned epoxy resin, a cresol novolak mold epoxy resin, the bisphenol A mold epoxy resin, a bisphenol female mold epoxy resin, a phenol novolak mold epoxy resin, an alkylphenol novolak mold epoxy resin, a biphenol female mold epoxy resin, a naphthalene mold epoxy resin, a dicyclopentadiene mold epoxy resin, the epoxidation object of the condensate of phenols and the aromatic aldehyde which has a phenolic hydroxyl group, triglycidyl isocyanurate, cycloaliphatic epoxy resin, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Thereby, it excels in thermal resistance etc.

[0052] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, polyphenylene sulfone, polyphenylene sulfide, a polyphenyl ether, polyether imide, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.

[0053] As matter of fusibility, an inorganic particle, a resin particle, metal particles, a rubber particle, liquid phase resin, liquid phase rubber, etc. are mentioned to the roughening liquid which consists of at least one sort chosen from the above-mentioned acid, alkali, and an oxidizer, for example, and an inorganic particle, a resin particle, and metal particles are desirable in these. Moreover, these may be used independently and may be used together two or more sorts.

[0054] As the above-mentioned inorganic particle, what consists of titanium compounds, such as silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, basic magnesium carbonate, and talc, a silica, and a zeolite, and a titania, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Dissolution clearance of the above-mentioned alumina particle can be carried out by fluoric acid, and dissolution clearance of the calcium carbonate can be carried out with a hydrochloric acid. Moreover, dissolution clearance of a sodium content silica or the dolomite can be carried out in an alkali water solution.

[0055] As the above-mentioned resin particle, what consists of thermosetting resin, thermoplastics, etc. is mentioned, for example. When immersed in the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer It will not be limited especially if a dissolution rate is earlier than the above-mentioned heat-resistant-resin matrix. Specifically For example, what consists of amino resin (melamine resin, a urea-resin, guanamine resin, etc.), an epoxy resin, phenol resin, phenoxy resin, polyimide resin, polyphenylene resin, polyolefin resin, a fluororesin, bismaleimide-triazine resin, etc. is mentioned. These may be used independently and may be used together two or more sorts. In addition, the above-mentioned resin particle needs to carry out hardening processing beforehand. It is because the above-mentioned resin particle dissolves in the solvent in which a resin matrix is dissolved, so homogeneity will be mixed and dissolution clearance only of the resin particle can be selectively carried out neither with an acid nor an oxidizer, unless it makes it harden.
[0056] As the above-mentioned metal particles, what consists of gold, silver, copper, tin, zinc, stainless steel, aluminum, nickel, iron, lead, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, the surface may be covered with resin etc. in order that the above-mentioned metal particles may secure insulation.
[0057] When two or more sorts are mixed and it uses the matter of the above-mentioned fusibility, as a combination of the matter of two sorts of fusibility to mix, the combination of a resin particle and an inorganic particle is desirable. the resin insulating layer between layers which adjustment of thermal expansion tends to plan them between poorly soluble resin, and they become from the resin constituent for roughening side formation while both of conductivity can be hurt low and can secure the insulation of the resin insulating layer between layers — a crack — not generating — the resin insulating layer between layers, and a conductor — it is because exfoliation does not occur between circuits.
[0058] It is desirable to use an organic acid in these as an acid used as the above-mentioned roughening liquid, for example, although organic acids, such as a phosphoric acid, a hydrochloric acid, a sulfuric acid, a nitric acid, and formic acid, an acetic acid, etc. are mentioned. It is because it is hard to make the metallic conductor layer exposed from the Bahia hall corrode when roughening processing is carried out. Moreover, a sodium hydroxide, a potassium hydroxide, etc. are mentioned as the above-mentioned alkali. As the above-mentioned oxidizer, it is desirable to, use the water solution of a chromic acid, chromate acid mixture, and alkaline permanganates (potassium permanganate etc.) etc. for example.
[0059] The mean particle diameter of the matter of the above-mentioned fusibility has desirable 10 micrometers or less. Moreover, big coarse grain and mean particle diameter may use it combining a small particle relatively relatively [mean particle diameter / the mean particle diameter of 2 micrometers or less]. That is, it is combining the matter of the fusibility whose mean particle diameter's is 0.1-0.8 micrometers, and the matter of the fusibility whose mean particle diameter's is 0.8-2.0 micrometers etc.
[0060] Thus, when big coarse grain and mean particle diameter combine a small particle relatively relatively [particle / average], the dissolution residue of the nonelectrolytic plating film can be lost, the amount of palladium catalysts under plating resist can be lessened, and a still shallower and complicated roughening side can be formed. Furthermore, by forming a complicated roughening side, even if the irregularity of a roughening side is small, the practical Peel reinforcement is maintainable.
[0061] (4) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened resin insulating layer, form opening for the Bahia halls and consider as the resin insulating layer between layers. Moreover, at this process, a breakthrough may be formed if needed. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. Moreover, when a photopolymer is used as an ingredient of the resin insulating layer between layers, you may form by the exposure development.
[0062] Moreover, in forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls is formed in the resin layer which consists of thermoplastics, and it considers as the resin insulating layer between layers. In this case, opening for the Bahia halls can be formed by giving the lasing. Moreover, what is necessary is just to form this breakthrough by drilling, the lasing, etc., when forming a breakthrough at this process.
[0063] As laser used for the above-mentioned lasing, carbon dioxide gas laser, ultraviolet laser, excimer laser, etc. are mentioned, for example. In these, excimer laser and the carbon dioxide gas laser of a short pulse are desirable.
[0064] Moreover, it is desirable also in excimer laser to use the excimer laser of a hologram method. A hologram method is a method which irradiates a laser beam through a hologram, a condenser lens, a laser mask, an imprint lens, etc. at the specified substance, and much openings can be once formed in a resin film layer efficiently by exposure by using this method.
[0065] Moreover, when using carbon dioxide gas laser, as for the pulse separation, it is desirable that they are

10-4 - 10 to 8 seconds. Moreover, as for the time amount which irradiates the laser for forming opening, it is desirable that it is 10 - 500 microseconds. Moreover, much openings for the Bahia halls can be formed at once by irradiating a laser beam through an optical-system lens and a mask. By minding an optical-system lens and a mask, it is the same reinforcement and is because exposure reinforcement can irradiate the same laser beam at two or more parts. Thus, after forming opening for the Bahia halls, DESUMIA processing may be performed if needed.

[0066] (5) Next, form a thin film conductor layer in the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls. The above-mentioned thin film conductor layer can be formed by approaches, such as nonelectrolytic plating and sputtering.

[0067] As construction material of the above-mentioned thin film conductor layer, copper, nickel, tin, zinc, cobalt, a thallium, lead, etc. are mentioned, for example. In these, what consists of the copper from a point, copper, and nickel which are excellent in an electrical property, profitability, etc. is desirable. Moreover, as thickness of the above-mentioned thin film conductor layer, when forming a thin film conductor layer with nonelectrolytic plating, 0.3-2.0 micrometers is desirable and 0.6-1.2 micrometers is more desirable. Moreover, when forming by sputtering, 0.1-1.0 micrometers is desirable. In addition, in forming a thin film conductor layer with nonelectrolytic plating, it gives the catalyst beforehand to the front face of the resin insulating layer between layers. As the above-mentioned catalyst, a palladium chloride etc. is mentioned, for example.

[0068] Moreover, a roughening side may be formed in the front face of the resin insulating layer between layers before forming the above-mentioned thin film conductor layer. By forming a roughening side, the adhesion of the resin insulating layer between layers and a thin film conductor layer can be raised.

[0069] Moreover, when a breakthrough is formed at the process of the above (4), in case a thin film conductor layer is formed on the resin insulating layer between layers, it is good also as a through hole by forming a thin film conductor layer also in the wall surface of a breakthrough.

[0070] (6) Subsequently, form plating resist on the substrate with which the thin film conductor layer was formed in the front face. After the above-mentioned plating resist sticks for example, a photosensitive dry film, it can carry out adhesion arrangement of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and can form it by performing an exposure development.

[0071] (7) After that, perform electrolysis plating by making a thin film conductor layer into a plating bar, and form an electrolysis plating layer in the above-mentioned plating-resist agenesis section. As the above-mentioned electrolysis plating, copper plating is desirable. Moreover, the thickness of the above-mentioned electrolysis plating layer has desirable 5-20 micrometers. then, the thing for which the nonelectrolytic plating film and thin film conductor layer under the above-mentioned plating resist and this plating resist are removed -- a conductor -- a circuit (the Bahia hall is included) can be formed. What is necessary is just to perform clearance of the above-mentioned thin film conductor layer using etching reagents, such as mixed liquor of a sulfuric acid and a hydrogen peroxide, sodium persulfate, ammonium persulfate, a ferric chloride, and a cupric chloride, that what is necessary is just to perform clearance of the above-mentioned plating resist for example, using an alkali water solution etc. moreover, the above -- a conductor -- after forming a circuit, the catalyst on the resin insulating layer between layers may be removed using an acid or an oxidizer if needed. It is because lowering of an electrical property can be prevented. passing through the process of such (5) - (7) -- a conductor -- a circuit can be formed.

[0072] in addition -- although the approach of above-mentioned (5) - (7) is a semiadditive process -- this approach -- replacing with -- a fully-additive process -- a conductor -- a circuit may be formed. the conductor which used the dry film for the part on this electrolysis plating layer, formed etching resist, removed an etching-resist agenesis subordinate's electrolysis plating layer and thin film conductor layer by etching after that, and became independent by exfoliating etching resist further after specifically forming an electrolysis plating layer the whole surface on the thin film conductor layer formed by the same approach as the above (5) -- a circuit may be formed.

[0073] the conductor of others [additive process / such], such as a subtractive process, -- the manufacture approach of a circuit -- comparing -- since etching precision is high -- a more detailed conductor -- while being able to form a circuit -- a conductor -- the degree of freedom of a circuit design can improve and the formation field of organic system optical waveguide can be easily secured on the resin insulating layer between layers. moreover, the build up method -- a conductor -- a circuit may be formed.

[0074] Moreover, when a through hole is formed in the above (4) and the process of (5), it may be filled up with a resin filler in this through hole. Moreover, when filled up with a resin filler in a through hole, a wrap lid plating layer may be formed for the surface section of a resin filler layer by performing nonelectrolytic plating if needed.

[0075] (8) next, the thing for which roughening processing is performed on the front face of this lid plating layer, and the process of (3) - (7) is further repeated if needed when a lid plating layer is formed -- the both sides --

the resin insulating layer between layers, and a conductor — carry out laminating formation of the circuit and consider as a multilayer-interconnection plate. In addition, a through hole may be formed and it is not necessary to form at this process.
[0076] (9) Next, form organic system optical waveguide in the part on the resin insulating layer between layers of an outermost layer of drum. Beforehand formation of the above-mentioned organic system optical waveguide, for example on a base material, a mold releasing film, etc. A selective polymerization method, the approach using reactive ion etching and photolithography, The direct exposing method, the approach using injection molding, the photograph breeching method, the approach that combined these are used. It can carry out by sticking the film for organic system optical waveguide formation fabricated in the shape of a film on the resin insulating layer between layers, or using the above-mentioned approach and forming directly on the resin insulating layer between layers, etc.
[0077] On a mold releasing film etc., spreading membrane formation of the liquefied polymer used as the undershirt clad section is carried out by spin coating etc., heat hardening of this is carried out, after that, spreading membrane formation of the polymer which serves as a core layer on the undershirt clad section is carried out, and, specifically, for example, first, heat hardening of this is carried out. Next, a resist is applied on the surface of a core layer, a resist pattern is formed with photolithography, and patterning is carried out to the configuration of the core section by RIE (reactive ion etching) etc. Furthermore, organic film-like system optical waveguide can be formed by carrying out spreading membrane formation of the polymer used as the exaggerated clad section, and carrying out heat hardening of this on the undershirt clad section (a core section top being included), etc.
[0078] Moreover, it is desirable to form an optical-path conversion mirror in the above-mentioned organic system optical waveguide. Although it may be formed before the above-mentioned optical-path conversion mirror attaches organic system optical waveguide on the resin insulating layer between layers, and it may be formed after attaching it on the resin insulating layer between layers, it is desirable to form an optical-path conversion mirror beforehand except for the case where this organic system optical waveguide is directly formed on the resin insulating layer between layers. other members which can work easily and constitute a multilayer printed wiring board at the time of an activity, for example, a conductor, — it is because a blemish is attached to a circuit, the resin insulating layer between layers, etc. or there is no possibility of damaging these.
[0079] It is not limited especially as an approach of forming the above-mentioned optical-path conversion mirror, but the well-known formation approach can be used conventionally. Specifically, machining with the diamond saw and cutter whose head is 90 degrees of V types, processing by reactive ion etching, laser ablation, etc. can be used.
[0080] (10) Next, form a solder resist layer in the organic system optical waveguide agenesis section. The above-mentioned solder resist layer can be formed using the solder resist constituent which consists of for example, polyphenylene ether resin, polyolefin resin, a fluororesin, thermoplastic elastomer, an epoxy resin, polyimide resin, etc.
[0081] moreover, as solder resist constituents other than the above For example, the acrylate (meta) of a novolak mold epoxy resin, an imidazole curing agent, 2 functionality (meta) acrylic ester monomer, the polymer of with a molecular weight of about 500 to 5000 acrylic ester (meta), The fluid of the shape of a paste containing photosensitive monomers, such as thermosetting resin which consists of a bisphenol mold epoxy resin etc., and a multiple-valued acrylic monomer, a glycol ether system solvent, etc. is mentioned, and, as for the viscosity, it is desirable to be adjusted to 1 – 10 Pa-s at 25 degrees C. Moreover, as for the thickness of a solder resist layer, it is desirable that it is the same as that of the thickness of organic system optical waveguide. It is because the front face of a multilayer printed wiring board can be made flat by making both thickness the same. Furthermore, in order that a solder resist layer may play a role of the clad section depending on the case, the same thing of both thickness is desirable also at the point that loss at the time of the optical transmission in the core section can be made small.
[0082] (11) Next, form opening for mounting the substrate for IC chip mounting, and various surface mount mold electronic parts in the above-mentioned solder resist layer if needed. Formation of opening for mounting the above-mentioned substrate for IC chip mounting etc. can be performed using the approach of forming opening for the Bahia halls, and the same approach, i.e., an exposure development and the lasing. in addition, such opening may be formed only in the solder resist layer of one side, and a double-sided solder resist layer may boil it, respectively, and it may be formed. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for mounting the substrate for IC chip mounting etc. may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.
[0083] The diameter of opening of opening for mounting the substrate for IC chip mounting has desirable 500-1000 micrometers. Moreover, especially the configuration is not limited, for example, the shape of the shape of

cylindrical and an elliptic cylinder and the square pole, many prismatic forms, etc. are mentioned.
[0084] (12) next, the conductor exposed by forming opening for mounting the substrate for IC chip mounting etc. — if needed, a circuit part is covered with corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, and let it be a pad for surface mounts. In these, it is desirable to form an enveloping layer with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Although the above-mentioned enveloping layer can be formed according to plating, vacuum evaporationo, electrodeposition, etc., in these, it is desirable to form with plating from the point of excelling in the homogeneity of an enveloping layer.
[0085] (13) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned pad for surface mounts with soldering paste (for example, Sn/Ag=96.5 / 3.5 grades) through the mask with which opening was formed in the part equivalent to the above-mentioned pad for surface mounts if needed. Moreover, it is good also as PGA (Pin Grid Array) or BGA (Ball Grid Array) by using electroconductive glue etc., arranging a pin or forming a solder ball in an external substrate connection side if needed, in the solder resist layer of a field and an opposite hand which forms organic system optical waveguide. Although not limited especially as the above-mentioned pin, the pin of T mold is desirable. Moreover, as the construction material, covar, 42 alloys, etc. are mentioned, for example.
[0086] Moreover, after being filled up with soldering paste, before carrying out a reflow, the substrate for IC chip mounting and other surface mount mold electronic parts may be carried, and you may solder by carrying out a reflow after that here. In addition, although especially the sequence to carry out (soldering) of carrying the substrate for IC chip mounting and surface mount mold electronic parts in this case is not limited, it is desirable to carry behind what has many numbers of connection terminals.
[0087] In addition, the substrate for IC chip mounting and surface mount mold electronic parts can be mounted in a multilayer printed wiring board at this process by connecting a solder bump, the bump formed in BGA and surface mount mold electronic parts of the substrate for IC chip mounting even if it did not form PGA and BGA, and the above-mentioned pad for surface mounts. By passing through such a process, the multilayer printed wiring board of the first this invention can be manufactured.
[0088] Next, the multilayer printed wiring board of the second this invention is explained. the multilayer printed wiring board of the second this invention — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the multilayer printed wiring boards by which laminating formation was carried out, and it is characterized by boiling all on the resin insulating layer between layers of the outermost layer of drum of one side, and forming organic system optical waveguide.
[0089] the multilayer printed wiring board of the second this invention — a conductor — since both a lightwave signal and an electrical signal can be transmitted since a circuit and organic system optical waveguide are formed, and organic system optical waveguide is formed in the multilayer printed wiring board, it can contribute to the miniaturization of the terminal equipment for optical communication.
[0090] Organic system optical waveguide is formed in all on the resin insulating layer between layers of the outermost layer of drum of one side in the above-mentioned multilayer printed wiring board. Therefore, a lightwave signal can be transmitted through the above-mentioned organic system optical waveguide. Moreover, organic system optical waveguide is easily processible while excelling in adhesion with the resin insulating layer between layers.
[0091] The above-mentioned organic system optical waveguide is organic system optical waveguide which consists of for example, the core section and the clad section, the core section is formed in the lightwave signal transmission route in a multilayer printed wiring board, and the clad section is formed in other parts. When the organic system optical waveguide of such a configuration is formed, since a lightwave signal is shut up and transmitted to the core section, it can transmit a lightwave signal in a desired path by forming the core section in a desired location. moreover — in addition, the clad section — a conductor — a circuit and the resin insulating layer between layers can be protected.
[0092] As an ingredient of the above-mentioned organic system optical waveguide, especially if there is little absorption by the communication link wavelength range, it will not be limited, but specifically, the same thing as the ingredient used with the multilayer printed wiring board of the first this invention is mentioned. Moreover, also in the multilayer printed wiring board of the second this invention, particles, such as a resin particle, an inorganic particle, and metal particles, may be contained in the above-mentioned organic system optical waveguide.
[0093] In the above-mentioned multilayer printed wiring board, as organic system optical waveguide, it is desirable to form the optical waveguide for light-receiving and the optical waveguide for luminescence, and it is desirable that it is what consists of an ingredient with same above-mentioned optical waveguide for light-receiving and above-mentioned optical waveguide for luminescence in this case. It is because adjustment of a coefficient of thermal expansion etc. is easy for a scale or the formation to like.

[0094] Moreover, it is desirable to form the optical-path conversion mirror in the above-mentioned organic system optical waveguide. By forming an optical-path conversion mirror, it is because it is possible to change an optical path into a desired include angle.
[0095] Moreover, it is desirable to form opening for mounting opening and surface mount mold electronic parts for mounting the substrate for IC chip mounting in the above-mentioned organic system optical waveguide, and it is desirable to form opening of the BGA pad for mounting the substrate for IC chip mounting especially. When opening described above to organic system optical waveguide is formed, the substrate for IC chip mounting and surface mount mold electronic parts can be mounted on the surface of a multilayer printed wiring board, and, specifically, substrates for IC chip mounting, such as BGA in which the light emitting device and the photo detector are mounted with IC chip, can be mounted in the side in which the optical waveguide of a multilayer printed wiring board was formed.
[0096] Moreover, the solder resist layer may be formed also in the outermost layer of drum of a near substrate in which optical waveguide was not formed, and opening for mounting surface mount mold electronic parts etc. in this opening may be formed. When such opening is formed, after forming a surface mount layer pad in this opening if needed, surface mount mold electronic parts can be mounted. Moreover, PGA (Pin Grid Array) and BGA (BallGrid Array) can also be arranged in this opening, and, thereby, a multilayer printed wiring board, an external substrate, etc. can also be electrically connected to it.
[0097] Moreover, external substrate with which optical elements, such as a light emitting device and a photo detector, were mounted in the side in which the above-mentioned organic system optical waveguide is formed in the multilayer printed wiring board of the second this invention s (substrate for IC chip mounting etc.) When it connects through a solder bump, the above-mentioned multilayer printed wiring board and the above-mentioned external substrate can be certainly arranged to a position according to the self-alignment operation which solder has. Therefore, if the installation location of the organic system optical waveguide (core section) in the multilayer printed wiring board of this invention and the installation location of the optical element in the above-mentioned external substrate are exact, an exact lightwave signal can be transmitted among both.
[0098] In addition, it is thought that it happens in order that the surface tension which is going to become a globular form when solder is attached to a metal, while the operation which is going to exist in a stable configuration by near the center of opening with the fluidity to which self has [solder] a self-alignment operation at the time of reflow processing is said and, as for this operation, solder is crawled by organic system optical waveguide may work strongly. Though location gap has occurred to both in front of a reflow in case the above-mentioned external substrate is connected the above-mentioned multilayer printed wiring board top through the above-mentioned solder bump when this self-alignment operation is used, the above-mentioned external substrate can move at the time of a reflow, and this external substrate can be attached in the exact location on the above-mentioned multilayer printed wiring board.
[0099] Moreover, as for opening for mounting the above-mentioned substrate for IC chip mounting etc., it is desirable to be formed in the clad section of organic system optical waveguide. It is because transmission of a lightwave signal is not checked.
[0100] moreover, the conductor which sandwiched the resin insulating layer between layers also in the multilayer printed wiring board of the second this invention by the same reason as the multilayer printed wiring board of the first this invention — the Bahia hall connects between circuits — desirable — the above — a conductor — as for a circuit, being formed by the additive process is desirable. moreover, the multilayer printed wiring board of the second this invention — also setting — a conductor — the circuit may be formed by the build up method.
[0101] In the multilayer printed wiring board of the second this invention, it is desirable to form the solder resist layer on the resin insulating layer between layers of the outermost layer of drum of a side and an opposite hand in which organic system optical waveguide was formed. forming a solder resist layer — a conductor — it is because a circuit and the resin insulating layer between layers can be protected.
[0102] Moreover, when the above-mentioned solder resist layer is formed, it is desirable to form opening for mounting surface mount mold electronic parts etc. in this solder resist layer. When the above-mentioned opening is formed in the solder resist layer, various surface mount mold electronic parts etc. can be mounted in this solder resist layer side. Moreover, PGA (Pin Grid Array) and BGA (Ball Grid Array) can be arranged in the above-mentioned opening, and, thereby, a multilayer printed wiring board, an external substrate, etc. can also be connected electrically.
[0103] Moreover, also when an external substrate is connected to the side in which this solder resist layer is formed through a solder bump, the above-mentioned multilayer printed wiring board and the above-mentioned external substrate can be certainly arranged to a position according to the self-alignment operation which solder has.
[0104] An example of the operation gestalt of the multilayer printed wiring board which consists of the above-

mentioned configuration hereafter is explained referring to a drawing. Drawing 2 is the sectional view showing typically 1 operation gestalt of the multilayer printed wiring board of the second this invention.
[0105] it is shown in drawing 2 — as — a multilayer printed wiring board 200 — both sides of a substrate 201 — a conductor — the conductor with which laminating formation was carried out and the substrate 201 of the resin insulating layer [a circuit 204 and] 202 between layers was pinched — the conductor which sandwiched circuits and the resin insulating layer 202 between layers — circuits are electrically connected by the through hole 209 and the Bahia hall 207, respectively. Moreover, the outermost layer of drum of one side was equipped with the solder bump 217, the organic system optical waveguide 218 which consisted of core section 218a and 218a', and clad section 218b and 218b' was formed, and the organic system optical waveguide 218 equips the part (edge of core section 218a and 218a') with the optical-path conversion mirror 220. In addition, in the organic system optical waveguide 218, core section 218a and clad section 218b of the perimeter play the role of the optical waveguide for light-receiving, and core section 218a' and clad section 218b' of the perimeter play the role of the optical waveguide for luminescence. Of course, both role may be reverse. Moreover, the solder resist layer 214 equipped with the solder bump 217 is formed in the outermost layer of drum of a side and an opposite hand in which the organic system optical waveguide 218 was formed.
[0106] In the multilayer printed wiring board 200 which consists of such a configuration, the lightwave signal sent from the outside through an optical fiber (not shown) etc. will be introduced into the organic system optical waveguide 218 (core section 218a), and will be sent to a photo detector (not shown) etc. through the optical-path conversion mirror 220. moreover, the lightwave signal sent out from the light emitting device (not shown) etc. is introduced into the organic system optical waveguide 218 (core section 218a') through the optical-path conversion mirror 220, and is delivery outside as a lightwave signal through an optical fiber (not shown) etc. further — it will be carried out.
[0107] Moreover, when external substrates (not shown), such as a substrate for IC chip mounting, are connected through the solder bump 217, a multilayer printed wiring board 200 and an external substrate can be connected electrically, and further, when the optical element is mounted in this external substrate, a lightwave signal and an electrical signal can be transmitted between a multilayer printed wiring board 200 and an external substrate. In addition, the multilayer printed wiring board of the second this invention which consists of such a configuration as well as the multilayer printed wiring board of the first this invention can be used as a package substrate, a mother board, a daughter board, etc.
[0108] Next, how to manufacture the multilayer printed wiring board of the second this invention is explained. It differs in that the method of manufacturing the second this invention does not form a solder resist layer in the formation approach of organic system optical waveguide, and field of at least one of the two compared with the approach of manufacturing the multilayer printed wiring board of the first this invention. Therefore, suppose that the process which forms organic system optical waveguide is hereafter explained to a detail in explanation of the manufacture approach of the multilayer printed wiring board of the second this invention, and other processes are explained briefly.
[0109] manufacture of the multilayer printed wiring board of the second this invention — setting — first — (1) - (8) of the production process of the multilayer printed wiring board of the first this invention — the same — carrying out — both sides of a substrate — a conductor — the multilayer-interconnection plate by which laminating formation was carried out with the circuit and the resin insulating layer between layers is manufactured.
[0110] (2) Next, form organic system optical waveguide in all on the resin insulating layer between layers of the outermost layer of drum of one side. Formation of organic system optical waveguide can be performed by for example, a selective polymerization method, the method of using reactive ion etching and photolithography, the direct exposing method, the approach using injection molding, the photograph breeching method, the approach that combined these. Organic system optical waveguide can be formed by using the approach of specifically including the process which sticks organic system optical waveguide films, such as a process of following (a) - (c).
[0111] (a) First, on a base material, a mold releasing film, etc., carry out spreading membrane formation of the liquefied polymer used as the undershirt clad section by spin coating etc., carry out heat hardening of this, after that, carry out spreading membrane formation of the polymer which serves as a core layer on the undershirt clad section, and carry out heat hardening of this. Next, a resist is applied on the surface of a core layer, a resist pattern is formed with photolithography, and patterning is carried out to the configuration of the core section by RIE (reactive ion etching).
[0112] (b) Next, stick on the position of the resin insulating layer between layers of an outermost layer of drum the film which consists of the undershirt clad section and the core section. Moreover, on the film which consists of the above-mentioned undershirt clad section and the core section, it is desirable to form an optical-path

conversion mirror. Although it may be formed before the above-mentioned optical-path conversion mirror attaches the above-mentioned film on the resin insulating layer between layers, and it may be formed after attaching it on the resin insulating layer between layers, it is desirable to form an optical-path conversion mirror beforehand except for the case where organic system optical waveguide is directly formed on the resin insulating layer between layers. other members which can work easily and constitute a multilayer printed wiring board at the time of an activity, for example, a conductor, — it is because a blemish is attached to a circuit, the resin insulating layer between layers, etc. or there is no possibility of damaging these. The approach of using as the formation approach of the above-mentioned optical-path conversion mirror, in case the multilayer printed wiring board of the first this invention is manufactured, and the same approach can be used.
[0113] (c) Next, consider as organic system optical waveguide by carrying out spreading membrane formation of the polymer which serves as the exaggerated clad section the whole surface on the resin insulating layer between layers which stuck the film which consists of the undershirt clad section and the core section, and carrying out heat hardening of this etc. Moreover, even formation of this exaggerated clad section may be performed in tops, such as a mold releasing film, and the optical waveguide of this shape of a subsequent film may be stuck on the resin insulating layer between layers.
[0114] Moreover, it may replace with the approach of sticking a film which was mentioned above and which was formed beforehand, the undershirt clad section and the core section may be formed using the approach described above to the position on the resin insulating layer between layers, and the same approach, and the approach of forming the exaggerated clad section and making it into organic system optical waveguide may be used after that.
[0115] At this process, a solder resist layer is formed the side in which organic system optical waveguide was formed, if needed on the resin insulating layer between layers of the outermost layer of drum of an opposite hand. In addition, formation of a solder resist layer can be performed like (10) of the production process of the multilayer printed wiring board of the first this invention.
[0116] (3) Next, form opening for mounting the substrate for IC chip mounting, and surface mount mold electronic parts in organic system optical waveguide if needed. Formation of opening for mounting the above-mentioned substrate for IC chip mounting etc. can be performed using the lasing, and the laser used as laser used for this lasing in case opening for the Bahia halls is formed, the same laser, etc. are mentioned. Moreover, the diameter of opening of opening for mounting the above-mentioned substrate for IC chip mounting etc. has desirable 500-1000 micrometers. Moreover, especially the configuration is not limited, for example, the shape of the shape of cylindrical and an elliptic cylinder and the square pole, many prismatic forms, etc. are mentioned. Moreover, in case the exaggerated clad section is formed, beforehand, the film which has opening in a desired location may be produced, and the organic system optical waveguide which has opening for mounting the substrate for IC chip mounting etc. may be formed by sticking this film.
[0117] Moreover, when a solder resist layer is formed at the process of the above (2), opening for mounting surface mount mold electronic parts etc. may be formed like (11) of the production process of the multilayer printed wiring board of the first this invention.
[0118] (4) Next, perform formation of the pad for surface mounts, a solder bump's formation, PGA, arrangement of BGA, etc. if needed like (12) of the production process of the multilayer printed wiring board of the first this invention, and (13). Moreover, like the case where the multilayer printed wiring board of the first this invention is manufactured, after being filled up with soldering paste, you may solder by carrying the substrate for IC chip mounting etc. In addition, the substrate for IC chip mounting and surface mount mold electronic parts can be mounted in a multilayer printed wiring board at this process by connecting a solder bump, the bump formed in BGA and surface mount mold electronic parts of the substrate for IC chip mounting even if it did not form PGA and BGA, and the above-mentioned pad for surface mounts. By passing through such a process, the multilayer printed wiring board of the second this invention can be manufactured.
[0119]
[Example] Hereafter, this invention is further explained to a detail.
(Example 1)
A. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of the resin film for the resin insulating layers between layers, The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding

article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film for the resin insulating layers between layers was produced by making it dry for 10 minutes at 80-120 degrees C.
[0120] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U) 100 weight section of the resin constituent for breakthrough restoration and a front face B. By 1.6 micrometers the diameter of grain of maximum size — SiO2 spherical particle (the Adtec Corp. make —) 15 micrometers or less CRS The viscosity prepared the resin filler of 45 - 49 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE170 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.
[0121] C. Copper clad laminate which 18-micrometer copper foil 8 laminates to both sides of the insulating substrate 1 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of a multilayer printed wiring board was used as the start ingredient (refer to drawing 3 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern — both sides of a substrate 1 — a conductor — the circuit 4 and the through hole 9 were formed.
[0122] (2) a through hole 9 and a conductor — the conductor which washes in cold water the substrate in which the circuit 4 was formed, carries out software etching after carrying out acid cleaning, and, subsequently to both sides of a substrate, includes the through hole 9 by sending with a conveyance roll after spraying an etching reagent by the spray — the roughening side (not shown) was formed in the front face of a circuit 4 (refer to drawing 3 (b)). As an etching reagent, it is imidazole copper. The etching reagent (the product made from MEKKU, MEKKU dirty bond) which consists of the (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.
[0123] (3) the following approach after preparing the resin filler indicated to Above B — after preparation — less than 24 hours — the conductor of one side of the inside of a through hole 9, and a substrate 1 — the circuit agenesis section and a conductor — the layer of resin filler 10' was formed in the rim section of a circuit 4. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 10' was formed by making it dry on 100 degrees C and the conditions for 20 minutes. subsequently, the conductor of the field of another side — the circuit agenesis section and a conductor — the layer of resin filler 10' was formed like the rim section of a circuit (refer to drawing 3 (c)).
[0124] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 10' might remain neither in the front face of a circuit 4, nor the land front face of a through hole 9, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 10 was formed.
[0125] thus, a through hole 9 and a conductor — the surface section of the resin filler 10 formed in the circuit agenesis section, and a conductor — the front face of a circuit 4 — flattening — carrying out — the resin filler 10 and a conductor — the insulating substrate which the side face of a circuit 4 stuck firmly through the roughening side, and the internal surface and the resin filler 10 of a through hole 9 stuck firmly through the roughening side was obtained (refer to drawing 3 (d)). this process — the front face of the resin filler layer 10, and a conductor — the front face of a circuit 4 turns into the same flat surface.
[0126] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 4, the land front face of a through hole 9, and a wall — a conductor — the roughening side was formed in all the front faces of a circuit 4. As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.
[0127] (6) Next, the somewhat larger resin film for the resin insulating layers between layers than the substrate produced by Above A was laid on the substrate, and after carrying out temporary sticking by pressure and

judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 2 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 3 (e)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for time amount 60 seconds, and heat curing of the resin film for the resin insulating layers between layers was carried out for 30 minutes at 170 degrees C after that.
[0128] (7) Next, mind the mask with which the breakthrough with a thickness of 1.2mm was formed on the resin insulating layer 2 between layers, and it is CO2 with a wavelength of 10.4 micrometers. By gas laser, the opening 6 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 2 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the breakthrough of a mask, and the conditions of one shot (refer to drawing 4 (a)).
[0129] (8) Next, plasma treatment was performed using Japanese vacuum-technology company make and SV-4540, and the front face of the resin insulating layer 2 between layers was roughened. Here, argon gas was used as inert gas and plasma treatment was performed for 2 minutes on power 200W, 0.6Pa of gas pressure, and conditions with a temperature of 70 degrees C. Next, after exchanging internal argon gas using the same equipment, sputtering which targeted nickel was performed using SV-4540 the condition for [atmospheric-pressure / of 0.6Pa /, temperature / of 80 degrees C /, power 200W, and time amount] 5 minutes, and the metal layer which consists of nickel was formed in the front face of the resin insulating layer 2 between layers. In addition, the thickness of nickel layer is 0.1 micrometers.
[0130] (9) Next, the substrate in which nickel layer was formed into the non-electrolytic copper plating water solution of the following presentations was immersed, and the non-electrolytic copper plating film with a thickness of 0.6-3.0 micrometers was formed on nickel layer (refer to drawing 4 (b)). In addition, in drawing 4 (b), the layer which consists of a nickel layer and non-electrolytic copper plating film is indicated to be the thin film conductor layer 12.
[Nonelectrolytic plating water solution]
NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]
It is 40 minutes [0131] by whenever [30-degree C solution temperature]. (10) Next, stick a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film 12 was formed, lay a mask, and it is 100 mJ/cm2. The plating resist 3 with a thickness of 20 micrometers was formed by exposing and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 4 (c)).
[0132] (11) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 13 with a thickness of 20 micrometers was formed in the plating-resist 3 agenesis section (refer to drawing 4 (d)).
[Electrolysis plating liquid]
Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO GL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0133] (12) -- a conductor with a thickness of 18 micrometers which carries out etching processing of the nonelectrolytic plating film under the plating resist 3 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution clearance and consists of non-electrolytic copper plating film 12 and electrolytic copper plating film 13 further after carrying out exfoliation clearance of the plating resist 3 by NaOH 5% -- the circuit 5 (the Bahia hall 7 is included) was formed (refer to drawing 5 (a)).
[0134] (13) next, the thing for which the process of the process of above-mentioned (5) - (12) is repeated -- the upper resin insulating layer between layers, and a conductor -- laminating formation of the circuit was carried out (refer to drawing 5 (b) - drawing 5 (c)). furthermore, the approach used at the process of the above (5) and the same approach -- using -- the conductor of an outermost layer of drum -- the roughening side (not shown) was formed in the circuit 5 (the Bahia hall 7 is included), and the multilayer-interconnection plate was obtained.
[0135] (14) Next, the organic system optical waveguide 18 and 18' which use the following approaches for the position of the front face of the resin insulating layer 2 between layers of an outermost layer of drum, and have the optical-path conversion mirror 20 were formed (refer to drawing 6 (a)). In addition, the organic system optical waveguide 18 and 18' consist of core section 18a, 18a' and clad section 18b, and 18b', respectively. That is, beforehand, the organic system optical waveguide (micro parts company make : 25 micrometers in width of face of 25 micrometers, thickness) of the shape of a film which consists of PMMA by which the head formed 45-

degree optical-path conversion mirror in the end using the diamond saw which is 90 degrees of V types was stuck so that the side face of the other end by the side of optical-path conversion mirror agenesis and the side face of the resin insulating layer between layers might gather. Moreover, attachment of organic system optical waveguide applies to the adhesion side with the resin insulating layer between layers of this organic system optical waveguide the adhesives which consist of thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour. In addition, in this example, although hardened on the conditions of 60 degrees C / 1 hour, step hardening may be performed depending on the case. It is because it is hard to generate stress by organic system optical waveguide at the time of attachment.

[0136] (15) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make --) dissolved in the methyl ethyl ketone trade name: -- the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku -- formation -- shrine make --) trade name: -- 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make --) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: -- the R604 3.0 weight section -- the same -- a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make --) trade name: -- the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make --) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60rpm (min-1), in the case of rotor No.4 and 6rpm (min-1), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold).

[0137] (16) Next, with the organic system optical waveguide agenesis section on the resin insulating layer between layers of the side in which the organic system optical waveguides 18a and 18b were formed, and this, the whole surface on the resin insulating layer between layers of an opposite hand, the above-mentioned solder resist constituent was applied, for 20 minutes was performed at 70 degrees C, desiccation processing was performed the condition for 30 minutes at 70 degrees C, and layer 14' of a solder REJISU constituent was formed (refer to drawing 6 (b)).

[0138] (17) Subsequently, opening for mounting the substrate for IC chip mounting in layer 14' of the solder resist constituent of the side in which organic system optical waveguide was formed was formed with laser. Furthermore, the photo mask with a thickness of 5mm with which the pattern of opening for mounting surface mount mold electronic parts in layer 14' of the solder resist constituent of the side which did not form organic system optical waveguide was drawn is stuck in a solder resist layer, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening for mounting the surface mount mold electronic parts of the configuration of arbitration and size was formed. Furthermore, it carried out at 120 degrees C for 1 hour for 1 hour, heat-treated [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, the layer of a solder resist constituent was stiffened, and the solder resist layer 14 which has opening for mounting the substrate for IC chip mounting, surface mount die parts, etc. was formed in both sides of a substrate (refer to drawing 7 (a)). In addition, a commercial solder resist constituent can also be used as the above-mentioned solder resist constituent.

[0139] (18) Next, the substrate in which the solder resist layer 14 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 15 for mounting the substrate for IC chip mounting etc. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10-1 mol/l), a sodium citrate (1.2x10 to 1 mol/l.), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the pad 16 for surface mounts.

[0140] (19) Next, it considered as the multilayer printed wiring board by printing soldering paste (Sn/Ag=96.5/3.5) to the opening 15 for mounting the substrate for IC chip mounting formed in the solder resist layer 14, and carrying out a reflow at 250 degrees C (refer to drawing 7 (b)).

[0141] (Example 2) In the process of (14) of an example 1, the multilayer printed wiring board was manufactured like the example 1 except having used the organic system optical waveguide (50 micrometers in width of face of 50 micrometers, thickness) of the shape of a film which consists of fluorination polyimide which formed 45-degree optical-path conversion mirror in the end using the diamond saw whose head is 90 degrees of V types.

[0142] (Example 3) In the process of (14) of an example 1, the multilayer printed wiring board was manufactured like the example 1 except having used the organic system optical waveguide (50 micrometers in width of face of 50 micrometers, thickness) of the shape of a film which consists of an epoxy resin which formed 45-degree optical-path conversion mirror in the end using the diamond saw whose head is 90 degrees of V types.
[0143] (Example 4)
(1) The multilayer-interconnection plate was manufactured like the process of (1) - (13) of an example 1 (refer to drawing 3 - drawing 5).
[0144] (2) Next, the film which uses the following approaches for the position of the front face of the resin insulating layer 2 between layers of an outermost layer of drum, and becomes it from undershirt clad section 38b and 38b', and core section 38a and 38a' was produced, and the head formed 45-degree optical-path conversion mirror 40 in the end of this film using the diamond sow which is 90 degrees C of V types. Next, the film in which this optical-path conversion mirror was formed was stuck so that the side face of that other end by the side of optical-path conversion mirror agenesis and the side face of the resin insulating layer 2 between layers might gather (refer to drawing 8 (a)). In addition, attachment of organic system optical waveguide applies to the adhesion side with the resin insulating layer between layers of this organic system optical waveguide the adhesives which consist of thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour.
[0145] (The production approach of a film) First, on the mold releasing film, spreading membrane formation of the PMMA for undershirt clad section formation was carried out by spin coating, and heat hardening of this was carried out. Next, on the undershirt clad section, spreading membrane formation of the PMMA for core layer formation was carried out, and heat hardening of this was carried out. Furthermore, the resist was applied on the surface of the core layer, and the film which consists of the undershirt clad section and the core section was produced by forming a resist pattern with photolithography and carrying out pattern NINGU by reactive ion etching at the configuration of the core section. In addition, the thickness of a film was 10 micrometers.
[0146] (3) Next, the organic system optical waveguide 38 was formed in all on the resin insulating layer 2 between layers by applying and carrying out heat hardening of the PMMA for exaggerated clad section formation at the process of the above (2) all over resin insulating-layer 2 between layers up [of the side which stuck the film] (a film top being included). Moreover, on the resin insulating layer 2 between layers of the side in which organic system optical waveguide was formed, and an opposite hand, the solder resist constituent prepared by the same approach as the process of (15) of an example 1 was applied by the same approach as the process of (16) of an example 1, and layer 14' of a solder REJISU constituent was further formed by performing desiccation processing (refer to drawing 8 (b)).
[0147] (4) Next, opening for mounting the substrate for IC chip mounting in the organic system optical waveguide 38 by the lasing was formed. In addition, this opening was made into the diameter of 600 micrometers by pitch 1.27mm. Moreover, the opening 15 for mounting surface mount mold electronic parts in layer 14' of a solder resist constituent by the same approach as the process of (17) of an example 1 was formed, and it considered as the solder resist layer 14 (refer to drawing 9 (a)).
[0148] (5) Next, it considered as the multilayer printed wiring board like the process of (18) of an example 1, and (19) (refer to drawing 9 (b)).
[0149] (Example 5) In the process of (2) of an example 4, in case a film is produced It replaces with PMMA for undershirt clad section formation, and PMMA for core section formation. Produce a film using the fluorination polyimide for undershirt clad section formation, and the fluorination polyimide for core section formation, and it sets at the process of (3), respectively. It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4 except having formed organic system optical waveguide using the fluorination polyimide for exaggerated clad section formation.
[0150] (Example 6) In the process of (2) of an example 4, in case a film is produced Replace with PMMA for undershirt clad section formation, and PMMA for core section formation, and produce a film using the epoxy resin for undershirt clad section formation, and the epoxy resin for core section formation, and it sets at the process of (3), respectively. It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4 except having formed organic system optical waveguide using the epoxy resin for exaggerated clad section formation.
[0151] In the process of (2) of an example 4, in case a film is produced, replace with PMMA for undershirt clad section formation, produce a film using the epoxy resin for undershirt clad section formation, and it sets at the process of (3). (Example 7) It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4 except having formed organic system optical waveguide using the epoxy resin for exaggerated clad section formation.
[0152] The following assessment approach estimated the multilayer printed wiring board obtained in the

examples 1-7 by performing configuration observation of (1) organic system optical waveguide, detection of (2) lightwave signals, and (3) continuity checks.

[0153] About the multilayer printed wiring board of the configuration observation examples 1-7 of assessment approach (1) organic system optical waveguide, the cutter cut these multilayer printed wiring boards so that it might pass along organic system optical waveguide, and the cross section was observed.

[0154] (2) The substrate for IC chip mounting with which the photo detector and the light emitting device were mounted in the side in which the organic system optical waveguide of detection **** of a lightwave signal and the multilayer printed wiring board of examples 1-7 is formed was connected so that it might be arranged in the location where a photo detector and a light emitting device counter organic system optical waveguide (core section), respectively. Next, after attaching a detector in an exposed surface from the multilayer printed wiring board side face of the organic system optical waveguide (core section) which counters installation and a photo detector in an optical fiber at an exposed surface from the multilayer printed wiring board side face of the organic system optical waveguide (core section) which counters a light emitting device and making a lightwave signal calculate with delivery and IC chip through an optical fiber, the detector detected the lightwave signal.

[0155] (3) Like detection of the continuity-check above-mentioned lightwave signal, the substrate for IC chip mounting was connected to the multilayer printed wiring board, the continuity check was performed after that, and switch-on was evaluated from the result displayed on a monitor.

[0156] As for the multilayer printed wiring board of examples 1-7, two kinds of organic system optical waveguides, the optical waveguide for light-receiving and the optical waveguide for luminescence, were formed in the position as a result of the above-mentioned assessment. Moreover, in the multilayer printed wiring board of examples 1-7, the multilayer printed wiring board which connected the substrate for IC chip mounting, could detect the desired lightwave signal when a lightwave signal was transmitted, and was manufactured by this example became clear [having sufficient lightwave signal transmission ability]. Furthermore, in the multilayer printed wiring board of examples 1-7, in the continuity check at the time of connecting the substrate for IC chip mounting, it was satisfactory to the conductivity of an electrical signal, and it became clear that an electrical signal can also be transmitted with a lightwave signal. Furthermore, it was 0.3 dB/cm as a result of measuring loss with 850nm wavelength light of optical waveguide.

[0157]

[Effect of the Invention] Since both a lightwave signal and an electrical signal can be transmitted since it consists of a configuration mentioned above, and organic system optical waveguide is formed in the multilayer printed wiring board, the multilayer printed wiring board of the first and the second this invention can be contributed to the miniaturization of the terminal equipment for optical communication.

[Translation done.]

EXAMPLE

[Example] Hereafter, this invention is further explained to a detail.
(Example 1)
A. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of the resin film for the resin insulating layers between layers, The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film for the resin insulating layers between layers was produced by making it dry for 10 minutes at 80-120 degrees C.
[0120] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U) 100 weight section of the resin constituent for through tube restoration and a front face B. By 1.6 micrometers the diameter of grain of maximum size -- SiO2 spherical particle (the Adtec Corp. make --) 15 micrometers or less CRS The viscosity prepared the resin filler of 45 - 49 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE170 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.
[0121] C. Copper clad laminate which 18-micrometer copper foil 8 laminates to both sides of the insulating substrate 1 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of a multilayer printed wiring board was used as the start ingredient (refer to drawing 3 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern -- both sides of a substrate 1 -- a conductor -- the circuit 4 and the through hole 9 were formed.
[0122] (2) a through hole 9 and a conductor -- the conductor which washes in cold water the substrate in which the circuit 4 was formed, carries out software etching after carrying out acid cleaning, and, subsequently to both sides of a substrate, includes the through hole 9 by sending with a conveyance roll after spraying an etching reagent by the spray -- the roughening side (not shown) was formed in the front face of a circuit 4 (refer to drawing 3 (b)). As an etching reagent, it is imidazole copper. The etching reagent (the product made from MEKKU, MEKKU dirty bond) which consists of the (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.
[0123] (3) the following approach after preparing the resin filler indicated to Above B -- after preparation -- less than 24 hours -- the conductor of one side of the inside of a through hole 9, and a substrate 1 -- the circuit agenesis section and a conductor -- the layer of resin filler 10' was

formed in the rim section of a circuit 4. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 10' was formed by making it dry on 100 degrees C and the conditions for 20 minutes. subsequently, the conductor of the field of another side — the circuit agenesis section and a conductor — the layer of resin filler 10' was formed like the rim section of a circuit (refer to drawing 3 (c)).
[0124] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 10' might remain neither in the front face of a circuit 4, nor the land front face of a through hole 9, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 10 was formed.
[0125] thus, a through hole 9 and a conductor — the surface section of the resin filler 10 formed in the circuit agenesis section, and a conductor — the front face of a circuit 4 — flattening — carrying out — the resin filler 10 and a conductor — the insulating substrate which the side face of a circuit 4 stuck firmly through the roughening side, and the internal surface and the resin filler 10 of a through hole 9 stuck firmly through the roughening side was obtained (refer to drawing 3 (d)). this process — the front face of the resin filler layer 10, and a conductor — the front face of a circuit 4 turns into the same flat surface.
[0126] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 4, the land front face of a through hole 9, and a wall — a conductor — the roughening side was formed in all the front faces of a circuit 4. As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.
[0127] (6) Next, the somewhat larger resin film for the resin insulating layers between layers than the substrate produced by Above A was laid on the substrate, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 2 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 3 (e)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for time amount 60 seconds, and heat curing of the resin film for the resin insulating layers between layers was carried out for 30 minutes at 170 degrees C after that.
[0128] (7) Next, mind the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 2 between layers, and it is CO2 with a wavelength of 10.4 micrometers. By gas laser, the opening 6 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 2 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 4 (a)).
[0129] (8) Next, plasma treatment was performed using Japanese vacuum-technology company make and SV-4540, and the front face of the resin insulating layer 2 between layers was roughened. Here, argon gas was used as inert gas and plasma treatment was performed for 2 minutes on power 200W, 0.6Pa of gas pressure, and conditions with a temperature of 70 degrees C. Next, after exchanging internal argon gas using the same equipment, sputtering which targeted nickel was performed using SV-4540 the condition for [atmospheric-pressure / of 0.6Pa /, temperature / of 80 degrees C /, power 200W, and time amount] 5 minutes, and the metal layer which consists of nickel was formed in the front face of the resin insulating layer 2 between layers. In addition, the thickness of nickel layer is 0.1 micrometers.
[0130] (9) Next, the substrate in which nickel layer was formed into the non-electrolytic copper

plating water solution of the following presentations was immersed, and the non-electrolytic copper plating film with a thickness of 0.6-3.0 micrometers was formed on nickel layer (refer to drawing 4 (b)). In addition, in drawing 4 (b), the layer which consists of a nickel layer and non-electrolytic copper plating film is indicated to be the thin film conductor layer 12.
[Nonelectrolytic plating water solution]
NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]
It is 40 minutes [0131] by whenever [30-degree C solution temperature]. (10) Next, stick a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film 12 was formed, lay a mask, and it is 100 mJ/cm2. The plating resist 3 with a thickness of 20 micrometers was formed by exposing and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 4 (c)).
[0132] (11) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 13 with a thickness of 20 micrometers was formed in the plating-resist 3 agenesis section (refer to drawing 4 (d)).
[Electrolysis plating liquid]
Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO GL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0133] (12) — a conductor with a thickness of 18 micrometers which carries out etching processing of the nonelectrolytic plating film under the plating resist 3 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution removal and consists of non-electrolytic copper plating film 12 and electrolytic copper plating film 13 further after carrying out exfoliation removal of the plating resist 3 by NaOH 5% — the circuit 5 (the Bahia hall 7 is included) was formed (refer to drawing 5 (a)).
[0134] (13) next, the thing for which the process of the process of above-mentioned (5) - (12) is repeated — the upper resin insulating layer between layers, and a conductor — laminating formation of the circuit was carried out (refer to drawing 5 (b) - drawing 5 (c)). furthermore, the approach used at the process of the above (5) and the same approach — using — the conductor of the outermost layer — the roughening side (not shown) was formed in the circuit 5 (the Bahia hall 7 is included), and the multilayer-interconnection plate was obtained.
[0135] (14) Next, the organic system optical waveguide 18 and 18' which use the following approaches for the position of the front face of the resin insulating layer 2 between layers of the outermost layer, and have the optical-path conversion mirror 20 were formed (refer to drawing 6 (a)). In addition, the organic system optical waveguide 18 and 18' consist of core section 18a, 18a' and clad section 18b, and 18b', respectively. That is, beforehand, the organic system optical waveguide (micro parts company make : 25 micrometers in width of face of 25 micrometers, thickness) of the shape of a film which consists of PMMA by which the tip formed 45-degree optical-path conversion mirror in the end using the diamond saw which is 90 degrees of V types was stuck so that the side face of the other end by the side of optical-path conversion mirror agenesis and the side face of the resin insulating layer between layers might gather. Moreover, attachment of organic system optical waveguide applies to the adhesion side with the resin insulating layer between layers of this organic system optical waveguide the adhesives which consist of thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour. In addition, in this example, although hardened on the conditions of 60 degrees C / 1 hour, step hardening may be performed depending on the case. It is because it is hard to generate stress by organic system optical waveguide at the time of attachment.
[0136] (15) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make —) dissolved in the methyl ethyl ketone trade name: — the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku — formation — shrine make —) trade name: — 2

organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make --) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: -- the R604 3.0 weight section -- the same -- a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make --) trade name: -- the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make --) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60rpm (min-1), in the case of rotor No.4 and 6rpm (min-1), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold).
[0137] (16) Next, with the organic system optical waveguide agenesis section on the resin insulating layer between layers of the side in which the organic system optical waveguides 18a and 18b were formed, and this, the whole surface on the resin insulating layer between layers of the opposite side, the above-mentioned solder resist constituent was applied, for 20 minutes was performed at 70 degrees C, desiccation processing was performed the condition for 30 minutes at 70 degrees C, and layer 14' of a solder REJISU constituent was formed (refer to drawing 6 (b)).
[0138] (17) Subsequently, opening for mounting the substrate for IC chip mounting in layer 14' of the solder resist constituent of the side in which organic system optical waveguide was formed was formed with laser. Furthermore, the photo mask with a thickness of 5mm with which the pattern of opening for mounting surface mount mold electronic parts in layer 14' of the solder resist constituent of the side which did not form organic system optical waveguide was drawn is stuck in a solder resist layer, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening for mounting the surface mount mold electronic parts of the configuration of arbitration and size was formed. Furthermore, it carried out at 120 degrees C for 1 hour for 1 hour, heat-treated [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, the layer of a solder resist constituent was stiffened, and the solder resist layer 14 which has opening for mounting the substrate for IC chip mounting, surface mount die parts, etc. was formed in both sides of a substrate (refer to drawing 7 (a)). In addition, a commercial solder resist constituent can also be used as the above-mentioned solder resist constituent.
[0139] (18) Next, the substrate in which the solder resist layer 14 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 15 for mounting the substrate for IC chip mounting etc. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10-1 mol/l), a sodium citrate (1.2x10 to 1 mol/l.), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the pad 16 for surface mounts.
[0140] (19) Next, it considered as the multilayer printed wiring board by printing soldering paste (Sn/Ag=96.5/3.5) to the opening 15 for mounting the substrate for IC chip mounting formed in the solder resist layer 14, and carrying out a reflow at 250 degrees C (refer to drawing 7 (b)).
[0141] (Example 2) In the process of (14) of an example 1, the multilayer printed wiring board was manufactured like the example 1 except having used the organic system optical waveguide (50 micrometers in width of face of 50 micrometers, thickness) of the shape of a film which consists of fluorination polyimide which formed 45-degree optical-path conversion mirror in the end using the diamond saw whose tip is 90 degrees of V types.
[0142] (Example 3) In the process of (14) of an example 1, the multilayer printed wiring board was manufactured like the example 1 except having used the organic system optical waveguide (50 micrometers in width of face of 50 micrometers, thickness) of the shape of a film which consists of an epoxy resin which formed 45-degree optical-path conversion mirror in the end using the diamond saw whose tip is 90 degrees of V types.
[0143] (Example 4)
(1) The multilayer-interconnection plate was manufactured like the process of (1) - (13) of an

example 1 (refer to drawing 3 - drawing 5).
[0144] (2) Next, the film which uses the following approaches for the position of the front face of the resin insulating layer 2 between layers of the outermost layer, and becomes it from undershirt clad section 38b and 38b', and core section 38a and 38a' was produced, and the tip formed 45-degree optical-path conversion mirror 40 in the end of this film using the diamond sow which is 90 degrees C of V types. Next, the film in which this optical-path conversion mirror was formed was stuck so that the side face of that other end by the side of optical-path conversion mirror agenesis and the side face of the resin insulating layer 2 between layers might gather (refer to drawing 8 (a)). In addition, attachment of organic system optical waveguide applies to the adhesion side with the resin insulating layer between layers of this organic system optical waveguide the adhesives which consist of thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour.
[0145] (The production approach of a film) First, on the mold releasing film, spreading membrane formation of the PMMA for undershirt clad section formation was carried out by spin coating, and heat hardening of this was carried out. Next, on the undershirt clad section, spreading membrane formation of the PMMA for core layer formation was carried out, and heat hardening of this was carried out. Furthermore, the resist was applied on the surface of the core layer, and the film which consists of the undershirt clad section and the core section was produced by forming a resist pattern with photolithography and carrying out pattern NINGU by reactive ion etching at the configuration of the core section. In addition, the thickness of a film was 10 micrometers.
[0146] (3) Next, the organic system optical waveguide 38 was formed in all on the resin insulating layer 2 between layers by applying and carrying out heat hardening of the PMMA for exaggerated clad section formation at the process of the above (2) all over resin insulating-layer 2 between layers up [of the side which stuck the film] (a film top being included). Moreover, on the resin insulating layer 2 between layers of the side in which organic system optical waveguide was formed, and the opposite side, the solder resist constituent prepared by the same approach as the process of (15) of an example 1 was applied by the same approach as the process of (16) of an example 1, and layer 14' of a solder REJISU constituent was further formed by performing desiccation processing (refer to drawing 8 (b)).
[0147] (4) Next, opening for mounting the substrate for IC chip mounting in the organic system optical waveguide 38 by the lasing was formed. In addition, this opening was made into the diameter of 600 micrometers by pitch 1.27mm. Moreover, the opening 15 for mounting surface mount mold electronic parts in layer 14' of a solder resist constituent by the same approach as the process of (17) of an example 1 was formed, and it considered as the solder resist layer 14 (refer to drawing 9 (a)).
[0148] (5) Next, it considered as the multilayer printed wiring board like the process of (18) of an example 1, and (19) (refer to drawing 9 (b)).
[0149] (Example 5) In the process of (2) of an example 4, in case a film is produced It replaces with PMMA for undershirt clad section formation, and PMMA for core section formation. Produce a film using the fluorination polyimide for undershirt clad section formation, and the fluorination polyimide for core section formation, and it sets at the process of (3), respectively. It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4 except having formed organic system optical waveguide using the fluorination polyimide for exaggerated clad section formation.
[0150] (Example 6) In the process of (2) of an example 4, in case a film is produced Replace with PMMA for undershirt clad section formation, and PMMA for core section formation, and produce a film using the epoxy resin for undershirt clad section formation, and the epoxy resin for core section formation, and it sets at the process of (3), respectively. It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4 except having formed organic system optical waveguide using the epoxy resin for exaggerated clad section formation.
[0151] In the process of (2) of an example 4, in case a film is produced, replace with PMMA for undershirt clad section formation, produce a film using the epoxy resin for undershirt clad section formation, and it sets at the process of (3). (Example 7) It replaced with PMMA for exaggerated clad section formation, and the multilayer printed wiring board was manufactured like the example 4

except having formed organic system optical waveguide using the epoxy resin for exaggerated clad section formation.

[0152] The following evaluation approach estimated the multilayer printed wiring board obtained in the examples 1-7 by performing configuration observation of (1) organic system optical waveguide, detection of (2) lightwave signals, and (3) continuity checks.

[0153] About the multilayer printed wiring board of the configuration observation examples 1-7 of evaluation approach (1) organic system optical waveguide, the cutter cut these multilayer printed wiring boards so that it might pass along organic system optical waveguide, and the cross section was observed.

[0154] (2) The substrate for IC chip mounting with which the photo detector and the light emitting device were mounted in the side in which the organic system optical waveguide of detection **** of a lightwave signal and the multilayer printed wiring board of examples 1-7 is formed was connected so that it might be arranged in the location where a photo detector and a light emitting device counter organic system optical waveguide (core section), respectively. Next, after attaching the optical fiber in the exposure from the multilayer printed wiring board side face of the organic system optical waveguide (core section) which counters a light emitting device, attaching a detector in an exposure from the multilayer printed wiring board side face of the organic system optical waveguide (core section) which counters a photo detector and making a lightwave signal calculate with delivery and IC chip through an optical fiber, the detector detected the lightwave signal.

[0155] (3) Like detection of the continuity-check above-mentioned lightwave signal, the substrate for IC chip mounting was connected to the multilayer printed wiring board, the continuity check was performed after that, and switch-on was evaluated from the result displayed on a monitor.

[0156] As for the multilayer printed wiring board of examples 1-7, two kinds of organic system optical waveguides, the optical waveguide for light-receiving and the optical waveguide for luminescence, were formed in the position as a result of the above-mentioned evaluation. Moreover, in the multilayer printed wiring board of examples 1-7, the multilayer printed wiring board which connected the substrate for IC chip mounting, could detect the desired lightwave signal when a lightwave signal was transmitted, and was manufactured by this example became clear [having sufficient lightwave signal transmission ability]. Furthermore, in the multilayer printed wiring board of examples 1-7, in the continuity check at the time of connecting the substrate for IC chip mounting, it was satisfactory to the conductivity of an electrical signal, and it became clear that an electrical signal can also be transmitted with a lightwave signal. Furthermore, it was 0.3 dB/cm as a result of measuring loss with 850nm wavelength light of optical waveguide.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Since both a lightwave signal and an electrical signal can be transmitted since it consists of a configuration mentioned above, and organic system optical waveguide is formed in the multilayer printed wiring board, the multilayer printed wiring board of the first and the second this invention can be contributed to the miniaturization of the terminal equipment for optical communication.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing typically 1 operation gestalt of the multilayer printed wiring board of the first this invention.
[Drawing 2] It is the sectional view showing typically 1 operation gestalt of the multilayer printed wiring board of the second this invention.
[Drawing 3] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the first this invention.
[Drawing 4] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the first this invention.
[Drawing 5] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the first this invention.
[Drawing 6] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the first this invention.
[Drawing 7] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the first this invention.
[Drawing 8] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the second this invention.
[Drawing 9] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board of the second this invention.
[Description of Notations]
100,200 Multilayer printed wiring board
101 201 Substrate
102 202 Resin insulating layer between layers
104 and 204 a conductor — circuit
107 207 Bahia hall
109 209 Through hole
114 214 Solder resist layer
117 217 Solder bump
118 218 Organic system optical waveguide
120 220 Mirror for optical conversion

[Translation done.]